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PN - JP6057396 A 19940301

TI - FORMATION OF HEAT INSULATING THERMALLY SPRAYED LAYER

AB - PURPOSE: To easily obtain a heat insulating thermally sprayed layer which is uniform, has a high porosity and excellent in the thermal insulation property and, further, to improve the adhesive strength of the boundary between a base layer and the heat insulating thermally sprayed layer and the oxidation resistance, as well.

- CONSTITUTION: The base layer 11 is formed on a base material 10 and the thermally sprayed layer 12 of fine ceramic powders excellent in the thermal insulation property is formed thereon and further, powders mixed with the ceramic powders excellent in the thermal insulation property and a specific amount of  $\text{Si}_3\text{N}_4$  powders is melt-sprayed to form the thermally sprayed layer 13 having a high porosity. The  $\text{Si}_3\text{N}_4$  powders in the mixed powders are heated to a high temperature in the plasma-thermal spraying process and then gasified. Consequently, many porosities remain in the thermally sprayed layer 13 formed in the above-mentioned manner developing the thermally sprayed layer having a high porosity and excellent in the thermal insulation property. On the other hand, since the thermally sprayed layer 12 is dense, it tightly adheres to the base layer 11 and excellent in resistance to oxidation, as well.

I - C23C4/04 ; C23C4/12

PA - MAZDA MOTOR CORP

IN - ASAI YASUSHI; others: 03

ABV - 19940606

ABV - 018296

GR - C1209

AN - JP19920233066 19920807

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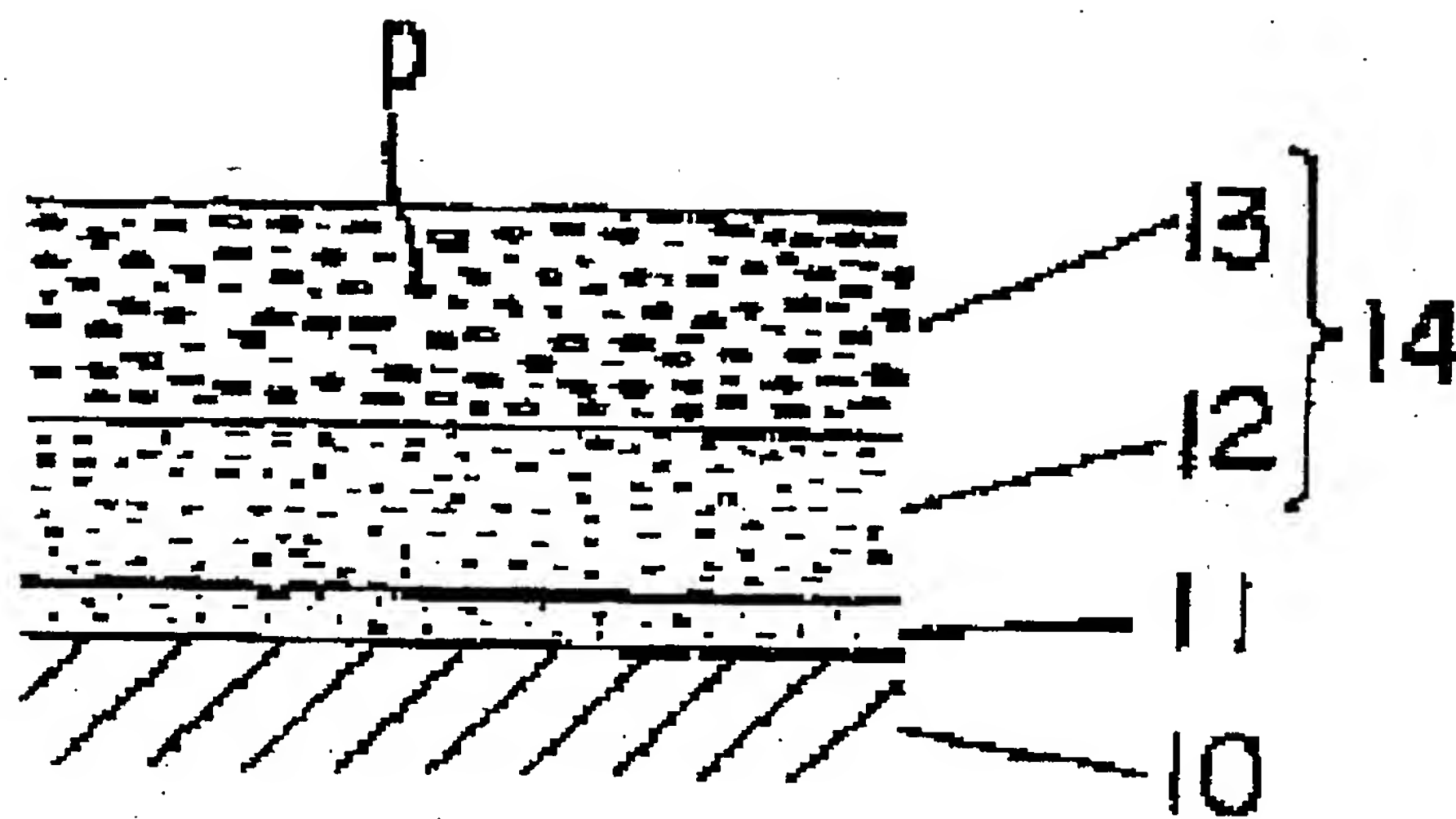
PN - JP6057396 A 19940301  
TI - FORMATION OF HEAT INSULATING THERMALLY SPRAYED LAYER  
FI - C23C4/04 ; C23C4/12  
PA - MAZDA MOTOR  
IN - ASAI YASUSHI; TAKESHIGE NOBUHIDE; KAWATO YASUSHI; UOSAKI YASUO  
AP - JP19920233066 19920807  
PR - JP19920233066 19920807  
DT - I

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○ - 1994-107175 [13]  
TI - Formation of heat insulating thermal sprayed layer - by forming a substrate layer on a matrix, forming a dense thermal sprayed layer of ceramic powder and forming a high porosity thermal sprayed water  
AB - J06057396 The layer is formed by forming a substrate layer on a matrix; forming a dense thermal sprayed layer of ceramic powder with good heat insulation, on the substrate layer, and forming a high porosity thermal sprayed layer by spraying mixed powder of ceramic powder with good heat resistance and a given amt. of SBN4 powder.  
○ - USE/ADVANTAGE - Used for heat insulation of the top of piston of engines or the inside of exhausting members. (Dwg0/1)  
IW - FORMATION HEAT INSULATE THERMAL SPRAY LAYER FORMING SUBSTRATE LATE MATRIX FORMING DENSE THERMAL SPRAY LAYER CERAMIC POWDER FORMING HIGH POROUS THERMAL SPRAY WATER  
○

PN - JP6057396 A 19940301 DW199413 C23C4/04 005pp  
IC - C23C4/04 ; C23C4/12  
MC - L02-D15D M13-H04  
DC - L02 M13  
PA - (TOYO ) TOYO KOGYO CO  
AP - JP19920233066 19920807  
PR - JP19920233066 19920807

## © PAJ / JPO



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**CLAIMS**

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[Claim(s)]

[Claim 1] The formation method of the thermal-barrier-spraying layer which carries out thermal spraying of the mixed-powder end excellent in adiathermancy of ceramic powder and  $\text{Si}_3\text{N}_4$  powder of the specified quantity on a base material, and is characterized by forming a thermal-spraying layer with high porosity.

[Claim 2] The formation method of the thermal-barrier-spraying layer which forms the precise thermal-spraying layer of the ceramic powder excellent in adiathermancy on a base material, carries out thermal spraying of the mixed-powder end of ceramic powder and  $\text{Si}_3\text{N}_4$  powder of the specified quantity it excelled on this at adiathermancy, and is characterized by forming a thermal-spraying layer with high porosity.

[Claim 3] The formation method of the thermal-barrier-spraying layer according to claim 1 or 2 characterized by the mixed-powder end excellent in adiathermancy of ceramic powder and  $\text{Si}_3\text{N}_4$  powder of the specified quantity being granulation powder.

[Claim 4] The ceramic powder excellent in adiathermancy is the formation method of the thermal-barrier-spraying layer according to claim 1 to 3 characterized by the bird clapper from  $\text{ZrO}_2$  and  $\text{Y}_2\text{O}_3$ .

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[Translation done.]

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2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Industrial Application] the method of this invention carrying out thermal spraying of the ceramic powder which was excellent in adiathermancy on the surface of the base material, and forming a thermal-barrier-spraying layer -- being related -- especially -- the piston crowning of an engine, and an exhaust air system -- it is related with the formation method of a thermal-barrier-spraying layer of having been suitable for insulating the interior of a member

[0002]

[Description of the Prior Art] in order to form a thermal-barrier-spraying layer in a piston crowning in order to raise the temperature of the combustion chamber at the time of engine starting at an early stage, or to prevent the fall of the exhaust gas temperature at the time of engine starting similarly and to raise the purification efficiency of a catalyst -- the member of an exhaust air system -- forming a thermal-barrier-spraying layer in an inside is known conventionally

[0003] When forming this thermal-barrier-spraying layer, first, the ground layer for the improvement in adhesion (for example, nickel-Cr layer) is formed in a base-material front face, and, subsequently to adiathermancy, the plasma metal spray of the powder of excellent ZrO<sub>2</sub> grade is carried out. Thus, the formed thermal-spraying layer has pore detailed inside as everyone knows, and the adiathermancy ability is excellent, so that porosity is high.

[0004] And the porosity of a thermal-spraying layer is adjusted by the grain size of thermal-spraying powder, when detailed powder is used, the thermal-spraying layer in which porosity is inferior to adiathermancy comparatively low is formed, and conversely, when the powder of coarse grain is used, the thermal-spraying layer porosity excelled [ layer ] in adiathermancy highly is formed. However, when the powder of coarse grain was used, it was difficult in the thermal-spraying layer to distribute pore uniformly, and it was difficult to obtain the thermal-spraying layer of the high porosity usually exceeding 10% moreover.

[0005] Moreover, detailed powder and the powder of coarse grain are mixed at a fixed rate, a plasma metal spray is carried out on a base material on the conditions on which the powder of coarse grain does not fuse this end of mixed powder completely, and the method of obtaining the thermal-barrier-spraying layer of high porosity is indicated by JP,63-161150,A. However, selection of the grain size of ceramic powder and a setup of spray condition are difficult for this method, and also in order for most powder of coarse grain not to fuse, it has the difficulty that the adhesion of particles tends to become inadequate.

[0006] Furthermore, in the conventional thermal-barrier-spraying layer, when raising adiathermancy ability and making porosity high utterly, there was also a trouble that the adhesion of a ground layer-thermal-barrier-spraying layer interface and oxidation-resistant aggravation generally were not avoided.

[0007]

[Problem(s) to be Solved by the Invention] In view of the trouble of the above-mentioned conventional technology, this invention sets it as one purpose to obtain easily the thermal-barrier-spraying layer which was excellent in adiathermancy ability with uniform and high porosity, and sets it as another purpose further to improve the adhesion of a ground layer-thermal-barrier-spraying layer interface, and oxidation resistance.



[0008]

[Means for Solving the Problem] Then, it carries out thermal spraying of the mixed-powder end excellent in adiathermancy of ceramic powder and  $\text{Si}_3\text{N}_4$  powder of the specified quantity on a base material, the formation method of the thermal-barrier-spraying layer in connection with this invention is characterized by forming a thermal-spraying layer with high porosity, and after forming the precise thermal-spraying layer of the ceramic powder excellent in adiathermancy on a base material preferably, it is characterized by forming a thermal-spraying layer with the above-mentioned high porosity. Moreover, in this invention, it is desirable to use ceramic powder and  $\text{Si}_3\text{N}_4$  powder of the specified quantity excellent in adiathermancy as granulation powder, and to carry out thermal spraying of this.

[0009] Although the ceramic which makes  $\text{ZrO}_2$  or  $\text{ZrO}_2$  a subject, and contains  $\text{Y}_2\text{O}_3$  as an assistant as a ceramic excellent in the adiathermancy set as the object of this invention is suitable, other ceramics used as  $\text{Al}_2\text{O}_3$  grade and a thermal spray material can be used. In addition, in the method of this invention, the high thermal-spraying layer or the precise thermal-spraying layer of porosity can also be directly formed on a base material, and can also be formed through ground layers, such as for example, a nickel-Cr layer.

[0010]

[Function] First, heating at high temperature of this invention is carried out in a thermal-spraying process according [  $\text{Si}_3\text{N}_4$  powder in the end of mixed powder ] to a plasma metal spray etc., and the phenomenon to gasify is used. Since  $\text{Si}_3\text{N}_4$  powder gasifies, much pores can remain in the thermal-spraying layer formed on the base material, and porosity can form easily the thermal-spraying layer which was highly excellent in adiathermancy.

[0011] By the way, although it is necessary to distribute  $\text{Si}_3\text{N}_4$  powder uniformly in the flow in the end of mixed powder supplied in order for pore to obtain the thermal-spraying layer distributed uniformly, when the grain size in the end of mixed powder differs greatly, it is difficult in many cases. Moreover, when the grain size of the powder supplied is small to remainder, it may be difficult to obtain the thermal-spraying layer over which a powdered flow is not stabilized but pore is distributed uniformly. Then, in this invention, in order to obtain a more uniform pore distribution, the end of mixed powder was used as granulation powder, and it carried out to distributing  $\text{Si}_3\text{N}_4$  powder uniformly in granulation powder. In this case, when there is no limit especially in the grain size of the ceramic powder excellent in adiathermancy, and  $\text{Si}_3\text{N}_4$  powder, for example,  $\text{Si}_3\text{N}_4$  detailed powder is used, detailed pore can obtain the thermal-spraying layer distributed uniformly.

[0012] In this invention, the porosity of a thermal-spraying layer is adjusted with the addition of  $\text{Si}_3\text{N}_4$  powder in the end of mixed powder, and the desirable addition range is 5 - 15 % of the weight. That is, if there is not effect sufficient at less than 5% for pore formation and 15% is exceeded, while pore will make it big and rough, it is to continuation-become easy toize and for the adhesion of an interface with a ground layer or a precise thermal-spraying layer to get worse.

[0013] By above-mentioned being within the limits and adding  $\text{Si}_3\text{N}_4$  powder, the porosity of a thermal-spraying layer can be made into about 10 - 25%, and a thermal-spraying layer with high porosity with high adiathermancy ability can be obtained. In addition, even if the porosity of the thermal-spraying layer when not adding  $\text{Si}_3\text{N}_4$  powder is high, it is only about 5 - 10%. Although the graph of 8%  $\text{Y}_2\text{O}_3$ -92%  $\text{ZrO}_2$  of thermal conductivity and porosity is shown in drawing 2 as one example, in the porosity range acquired by this invention, thermal conductivity is still smaller and it turns out that adiathermancy is excellent.

[0014] furthermore, the time of forming a thermal-spraying layer with the above-mentioned high porosity, after forming the precise thermal-spraying layer of the ceramic powder excellent in adiathermancy on a base material in this invention -- this -- since a precise thermal-spraying layer is excellent in the adhesion of a base material (or ground layer) and an interface and excellent also in oxidation resistance, it can obtain the thermal-barrier-spraying layer which has the special feature which was excellent in both as a whole

[0015]

[Example] Hereafter, one at the time of forming a thermal-barrier-spraying layer on a base material using the method of this invention of a manufacturing process is explained with reference to the block diagram shown in drawing 3. (1) First, using cast iron (FCD500) as a base material, use

solvents, such as (2) acetones, and it is shot blasting about washing, degreasing, and (3) base-material front face. Abrasive is the alumina particle of 40-50 meshes of grain size, and is 2 4kg [ /cm ] blast \*\*. (4) Form the ground layer of 30-micrometer \*\* on a base material by the plasma metal spray. A thermal spray material is in the 80nickel-20Cr alloy-powder end of 10-45-micrometer particle size. (5) Form the precise thermal-spraying layer of 200-micrometer \*\* on a ground layer by the plasma metal spray. A thermal spray material is 8%Y<sub>2</sub>O<sub>3</sub>-92%ZrO<sub>2</sub> powder with a particle size of 5-35 micrometers. (6) Form a thermal-spraying layer with the high porosity of 300-micrometer \*\* by the plasma metal spray. A thermal spray material is granulation powder (refer to drawing 4) with a particle size of 10-45 micrometers which blended Si<sub>3</sub>N<sub>4</sub> powder with a particle size of 2 micrometers or less 10%, and carried out mixing granulation to 8%Y<sub>2</sub>O<sub>3</sub>-92%ZrO<sub>2</sub> powder with a particle size of 5 micrometers or less.

[0016] The cross section of the thermal-barrier-spraying layer formed of the above-mentioned process is shown in drawing 1. According to drawing 1, the ground layer 11 is formed on a base material 10, and the thermal-spraying layer 13 with high porosity is formed on it on it at the precise thermal-spraying layer 12 and the pan. It is the pore which p shows. As shown here, the porosity of the thermal-spraying layer 12 is small, and since Si<sub>3</sub>N<sub>4</sub> gasified and dispersed, the porosity of the thermal-spraying layer 13 is high. Since the thermal-barrier-spraying layer 14 in this example consists of two-layer [ of the precise thermal-spraying layer 12 and the thermal-spraying layer 13 with high porosity ], while its adiabatic efficiency is high, its adhesion with the ground layer 2 is good, and it has the property that oxidation resistance is also high.

[0017] With reference to block drawing 3 with one same process, it explains conventionally for comparison. A different point from the above-mentioned example is a point which formed about 500-micrometer thermal-spraying layer on the ground layer by (7) plasma metal sprays instead of the above (5) and the process of (6). The grain size of 8%Y<sub>2</sub>O<sub>3</sub>-92%ZrO<sub>2</sub> used powder is also large with 45-100 micrometers. The cross section of the thermal-barrier-spraying layer formed of the process conventionally [ this ] is shown in drawing 5. Although the thermal-barrier-spraying layer 15 is formed on the ground layer 11, since the porosity is not enough compared with the thermal-spraying layer 13 of the above-mentioned example, it is inferior to adiathermancy, and since porosity is conversely large compared with the thermal-spraying layer 12 of the above-mentioned example, it is inferior to adhesion with the ground layer 11, and oxidation resistance.

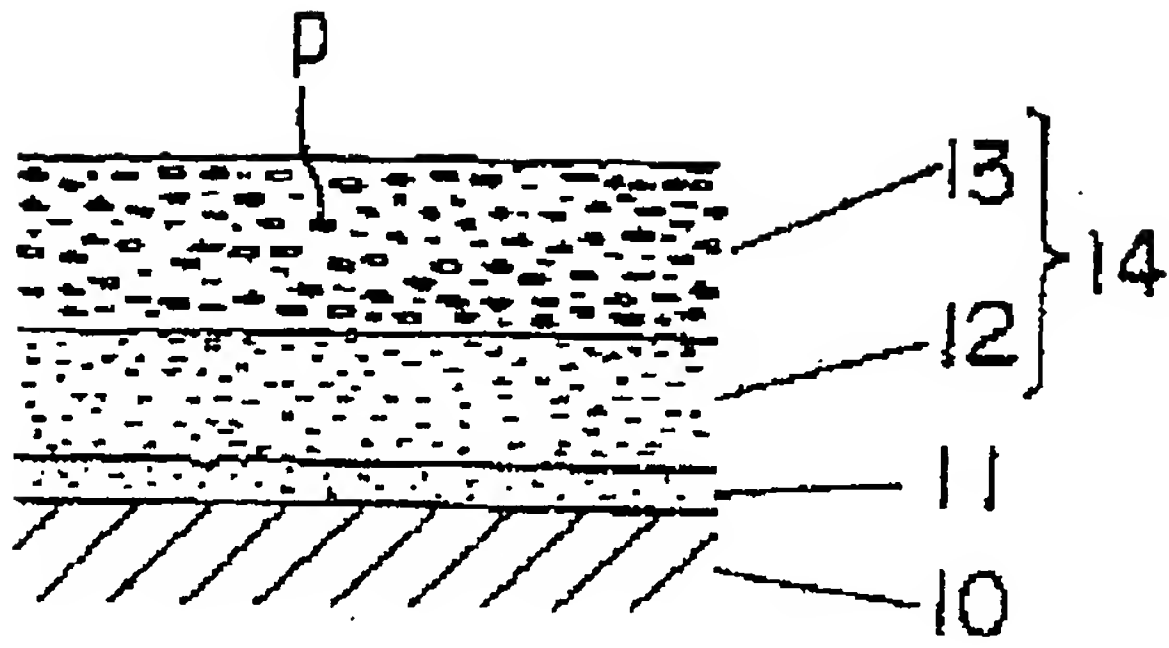
[0018]

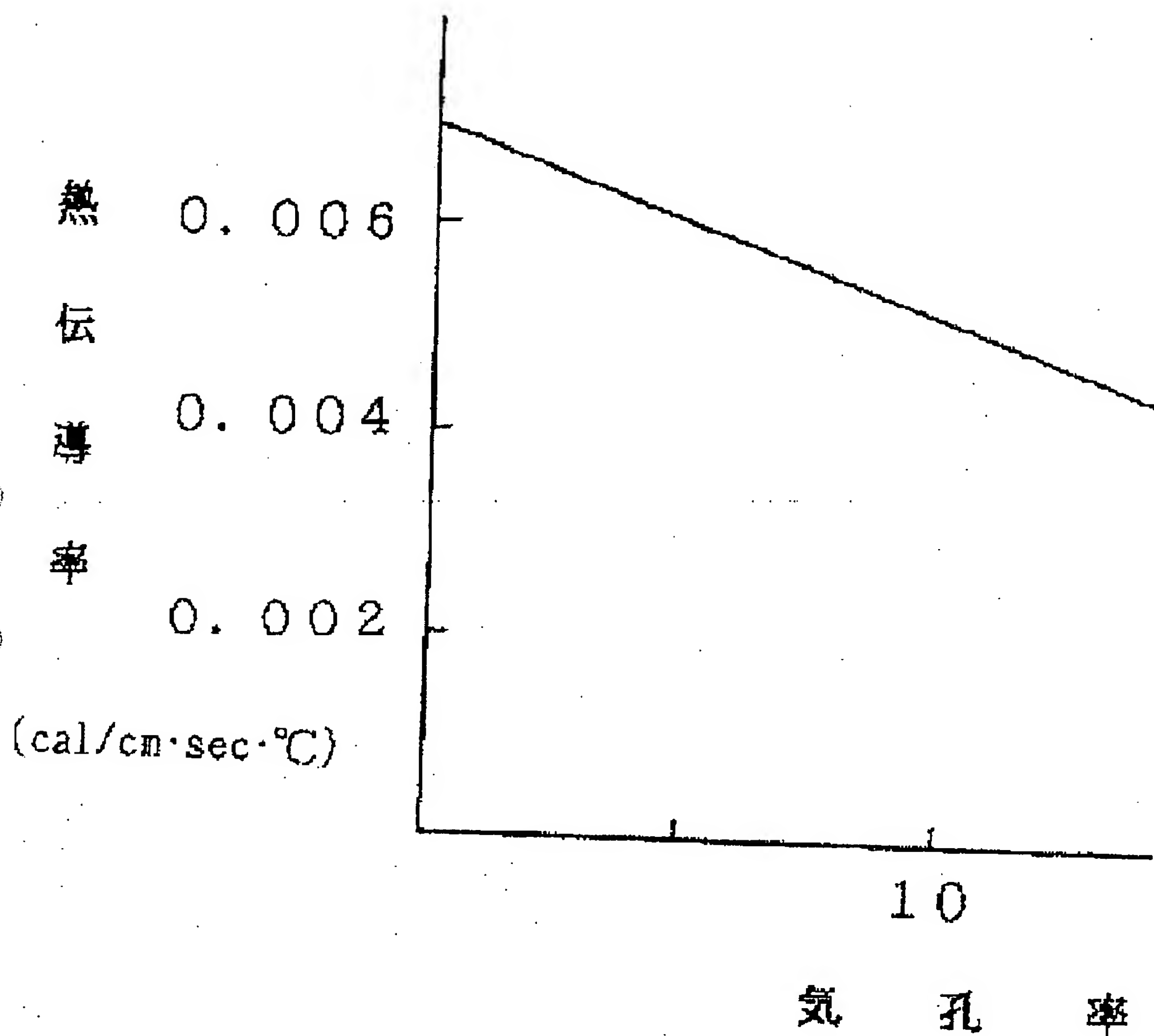
[Effect of the Invention] When the thermal-spraying layer of high porosity is formed after according to this invention being able to obtain easily the thermal-barrier-spraying layer which was excellent in adiathermancy ability with uniform and high porosity and forming the still more precise thermal-spraying layer on the base, the thermal-barrier-spraying layer improved also about adhesion with a base or a ground layer and oxidation resistance can be obtained.

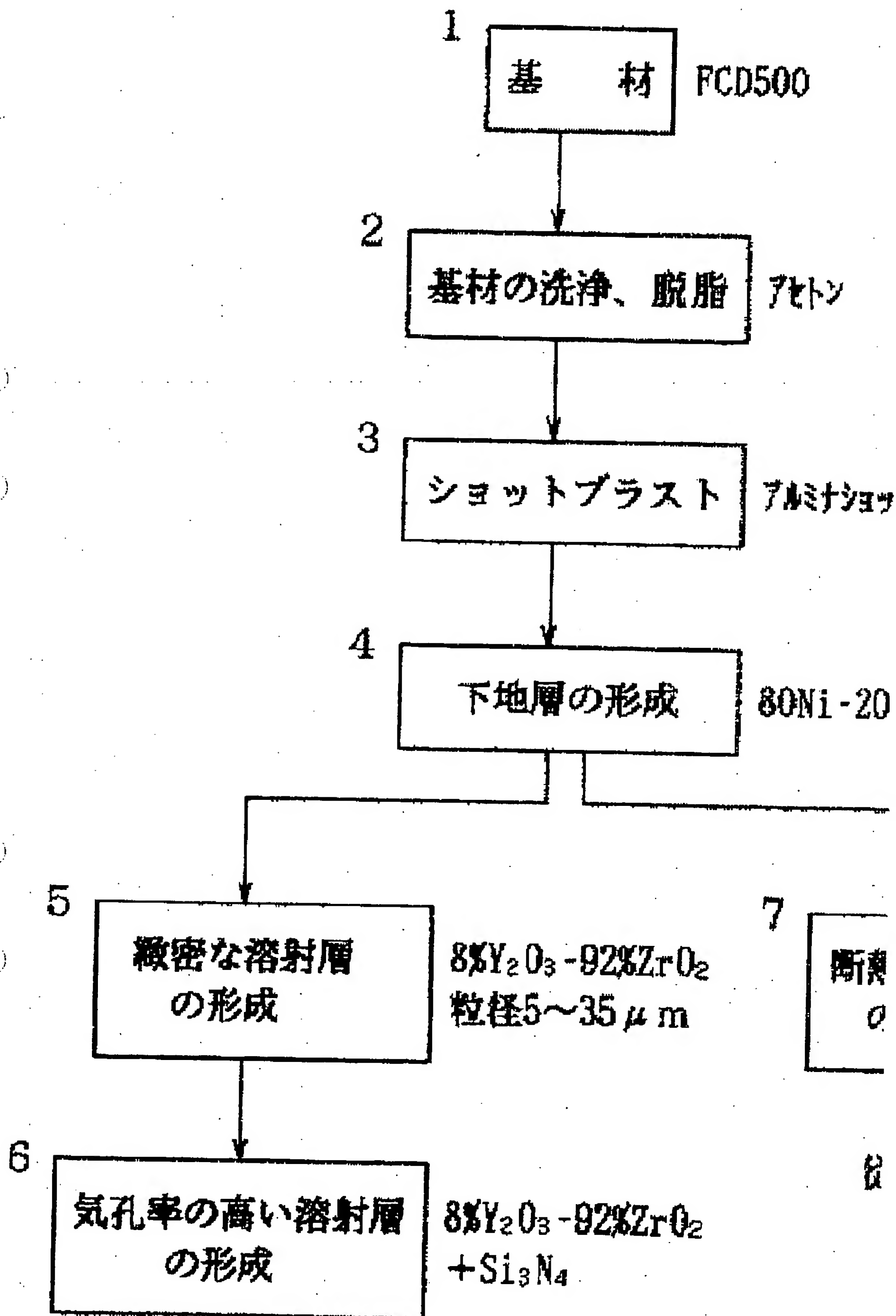
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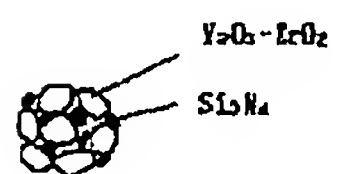






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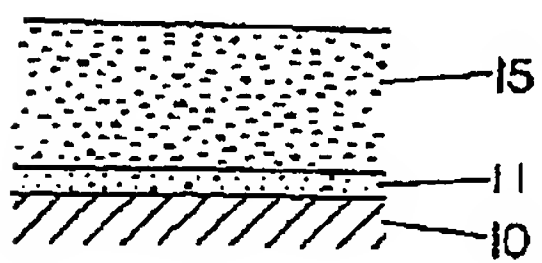
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